TÜV NORD (Hangzhou) Co., Ltd.

Room B409, Building 1, No.9,
Jiuhuan Road, Shangcheng,
District, Hangzhou City, Zhejiang
Province, 310019, P.R. China

Phone: +86 (0) 571 8538 6989
Fax: +86 (0) 571 8538 6986

hzpcert@tuv-nord.com
www.tuv-nord.com/cn

Test Report

No. TRPVP07017/25P/02

Commission Testing
according to IEC 61215-2 / EN IEC 61215-2

Applicant: **Solar Fabrik GmbH**
Hermann-Niggemann-Straße 7
D-63846 Laufach, Germany

File No.: PVP07017/25P-02

Designed: by: Yining Li Digitally signed by Yining Li Date: 2025.08.25 10:32:41 +08'00'
(Project Engineer)

Reviewed: by: Tony Ye Digitally signed by Tony Ye Date: 2025.08.25 10:33:08 +08'00'
(Technical Certifier)

TÜVNORD

Test Report

File No.: PVP07017/25P-02 Test Report No.: TRPVP07017/25P/02

Applicant ..... :	**Solar Fabrik GmbH** Hermann-Niggemann-Straße 7 D-63846 Laufach, Germany
Manufacturer ..... :	**Solar Fabrik GmbH** Hermann-Niggemann-Straße 7 D-63846 Laufach, Germany
Order No. ..... :	QT-PVP07017/25P
Date of Application ..... :	2025-07-02
Product ..... :	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules
Module type(s) ..... :	108 cells: S4-DGxxx-108BC-FB, S4-DGxxx-108BC-W, S4-DGxxx-108BC-B Remark: xxx indicates rated output power generated from front side under STC
General Information • Maximum System Voltage.... : • Electrical Protection Class.... :	 DC 1500V Class II
Type of examination ..... :	Commission testing only
Testing Period ..... :	2025-07-16/2025-07-17
Responsible Testing Laboratory :	**TÜV NORD Testing (Suzhou) Co., Ltd.** Zone E, 1st Floor, East side of South Building 3, No. 50, Beiguandu Road, Yuexi Street, Suzhou, Jiangsu Province, China

Test results listed in this test report refer exclusively to the mentioned test sample.

Partly copying is not permitted without explicit agreement of the owner.

The submitted test samples as described in the reports hereunder are based on the requirements:
IEC 61215-2:2021 / EN IEC 61215-2:2021 “Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures”

List of contents

Summary of testing
According to the enquiry of the applicant, a commission testing was performed according to IEC 61215-2:2021. Testing items are listed in page 8 of this report. At the end of the test, the passing criteria is that the maximum power degradation of each module is less than 5%. Test module: S4-DGxxx-108BC-FB was delivered to testing lab as test samples and conducted with all the related tests. According to the enquiry of the applicant, extend related module types: S4-DGxxx-108BC-W and S4-DGxxx-108BC-B, which have the same electrical circuitry and components as the tested module: S4-DGxxx-108BC-FB, but with the only difference of rear cover. S4-DGxxx-108BC-FB has rear cover with black grid, S4-DGxxx-108BC-W has rear cover with white grid, and S4-DGxxx-108BC-B has rear cover without grid. No additional test is required. All tests were successfully completed.

General remarks

Test item particulars:	
Accessories and detachable parts included in the evaluation .....:	N/A
Options included .....:	N/A
Abbreviations used in the report:	
HF - Humidity Freeze	TC - Thermal Cycling
DH - Damp Heat	EL - Electroluminescence
STC - Standard Test Conditions (1000W/m^2, AM1.5, 25°C)	BNPI - Bifacial nameplate irradiance, corresponding to 1000W/m^2 on the module front and 135 W/m^2 on the module rear
BSI - Bifacial stress irradiance, corresponding to 1000W/m^2 on the module front and 300W/m^2 on the module rear	aBSI - Applied bifacial stress irradiance, corresponding to 1000W/m^2 on the module front and more than 300W/m^2 or the manufacturer's claimed irradiance value on the module rear
P_{max} - Maximum power	I_{sc} - Short circuit current
V_{oc} - Open circuit voltage	I_{mp} - Maximum power current
V_{mp} - Maximum power voltage	FF - Fill factor
φ - Bifaciality refers to the ratios between the main I-V characteristics of the rear side and the front side of a bifacial device, typically at Standard Test Conditions (STC) unless otherwise specified. It is quantified with reference to bifaciality coefficients, namely as φ.	
φP_{max} - Maximum power bifaciality coefficient	φI_{sc} - Short circuit current bifaciality coefficient
φV_{oc} - Open-circuit voltage bifaciality coefficient	α - Current temperature coefficient
β - Voltage temperature coefficient	γ - Power temperature coefficient
Possible test case verdicts:	
Test case does not apply to the test object .....:	Not Applicable (N/A)
Test object does meet the requirement .....:	Pass (P)
Test object does not meet the requirement .....:	Fail (F)
Other remarks:	
The test verdicts presented in this report relate only to the object tested. This report shall not be reproduced except in full, without the written approval of the issuing testing laboratory. Sample #-front: Exposure under 1000W/m^2 on the front side with no irradiance on the rear side. Sample #-rear: Exposure under 1000W/m^2 on the rear side with no irradiance on the rear side. Sample #-BNPI: Exposure under BNPI on the front side with no irradiance on the rear side. "(see Annex #)" refers to additional information appended to the report. "(see Table #)" refers to a table appended to the report. Power degradation data expressed in negative value indicates a reduction of maximum power output. Power degradation data expressed in positive value indicates an increment of maximum power output. Throughout this report, a point is used as the decimal separator.	

Testing procedure

Module type: S4-DGxxx-108BC-FB

☐	Random sampling from production
☒	Prototype submitted by client
Supplementary information: N/A	

Module group assignment

Module type: S4-DGxxx-108BC-FB

Sample #	Serial number	Dimension (l x w x h) [mm]	Remark
1	ONP010055250700102623	1800 x 1134 x 30	Hail impact test (diameter of ice ball: 40mm)

Clause	Requirement + Test	Result - Remark	Verdict

Test result overview

Module type: S4-DGxxx-108BC-FB

Initial examinations			—
MQT 01	Visual inspection ..... :	See table 4.1	P
MQT 02	Maximum power determination..... :	See table 4.2	—
MQT 03	Insulation test..... :	See table 4.3	P
MQT 15	Wet leakage current test..... :	See table 4.15	P

Sample 1#			—
MQT 17	Hail test..... :	See table 4.17	P

Final examinations			—
MQT 01	Visual inspection ..... :	See table 4.1	P
MQT 15	Wet leakage current test..... :	See table 4.15	P
MQT 02	Maximum power determination..... :	See table 4.2	P
MQT 03	Insulation test..... :	See table 4.3	P

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

Test results of IEC 61215-2 / EN IEC 61215-2

Module type: S4-DGxxx-108BC-FB

4.1 Visual inspection (initial) - MQT 01		—
Test date [YYYY-MM-DD] .....:	2025-07-16	—
Sample #	Nature and position of initial findings - comments or attach photos	—
1	No visual defects	P
Supplementary information: N/A		

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

4.2 Maximum power determination (at STC, front side) - MQT 02							—
Test date [YYYY-MM-DD] .....:			2025-07-16				—
Test method .....:			☒ Solar simulator / ☐ Natural sunlight				—
Sample #	I_{sc} [A]	V_{oc} [V]	I_{mp} [A]	V_{mp} [V]	P_{max} [W]	FF [%]	—
1	14.231	40.161	13.569	34.667	470.39	82.31	—
Supplementary information: N/A							

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

4.3 Insulation test (initial) - MQT 03				—
Test date [YYYY-MM-DD] .....:		2025-07-16		—
Test voltage applied [V] .....:		2 minutes of 1500 and 1 minute of 8000		—
Sample #	Required [MΩ]	Measured [MΩ]	Dielectric breakdown?	—
1	19.6	>1000	No	P
Supplementary information: Minimum requirement according to the standard is 40MΩ·m^2. Area of the module is 2.04m^2.				

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

4.15 Wet leakage current test (initial) - MQT 15			—
Test date [YYYY-MM-DD] .....:		2025-07-16	—
Test voltage applied [V] .....:		2 minutes of 1500	—
Solution resistivity [Ω·cm] / <3500 .....:		2054	—
Solution temperature [°C] / 22±2 .....:		22.3	—
Sample #	Required [MΩ]	Measured [MΩ]	—
1	19.6	>1000	P
Supplementary information: Minimum requirement according to the standard is 40MΩ·m^2. Area of the module is 2.04m^2.			

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

4.17 Hail impact test - MQT 17								—
Sample #.....:	1							—
Test date [YYYY-MM-DD] .....:	2025-07-17							—
Number of impact locations .....:	11							—
Ice ball size [mm] .....:	1	2	3	4	5	6		—
	40.42	39.07	40.62	39.49	41.10	40.52		
	7	8	9	10	11	—		
	40.34	39.18	41.10	39.45	40.99	—		
Ice ball weight [g] .....:	1	2	3	4	5	6		—
	30.71	30.78	30.08	31.43	31.58	30.78		
	7	8	9	10	11	—		
	29.39	29.68	31.23	31.46	30.43	—		
Ice ball velocity [m/s].....:	1	2	3	4	5	6		—
	28.73	28.53	28.20	28.38	28.23	28.92		
	7	8	9	10	11	—		
	28.96	28.25	28.46	28.23	28.85	—		
Supplementary information: This test is performed according to the enquiry of the applicant. Ice balls with 40mm diameter are used based on IEC TS 63397:2022.								
4.1 Visual inspection (after hail impact test) - MQT 01								—
Test date [YYYY-MM-DD] .....:	2025-07-17							—
Sample #	Nature and position of initial findings - comments or attach photos							—
1	No visual defects							P
Supplementary information: N/A								
4.15 Wet leakage current test (after hail impact test) - MQT 15								—
Test date [YYYY-MM-DD] .....:	2025-07-17							—
Test voltage applied [V].....:	2 minutes of 1500							—
Solution resistivity [Ω·cm] / <3500 .....:	2083							—
Solution temperature [°C] / 22±2 .....:	22.0							—
Sample #	Required [MΩ]	Measured [MΩ]						—
1	19.6	>1000						P
Supplementary information: Minimum requirement according to the standard is 40MΩ·m^2. Area of the module is 2.04m^2.								

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

4.2 Maximum power determination (after hail impact test) - MQT 02							—
Test date [YYYY-MM-DD] .....:			2025-07-17				—
Ambient temperature [°C].....:			Corrected to 25.0				—
Irradiance [W/m^2].....:			Corrected to 1000				—
Sample #	I_{sc} [A]	V_{oc} [V]	I_{mp} [A]	V_{mp} [V]	P_{max} [W]	FF [%]	—
1-front	14.230	40.161	13.368	35.142	469.79	82.20	—
P_{max} degradation after test [%] / ≤5.....:			-0.13				P
Supplementary information: N/A							
4.3 Insulation test (after hail impact test) - MQT 03							—
Test date [YYYY-MM-DD] .....:			2025-07-17				—
Test voltage applied [V].....:			2 minutes of 1500 and 1 minute of 8000				—
Sample #	Required [MΩ]		Measured [MΩ]		Dielectric breakdown?		—
1	19.6		>1000		No		P
Supplementary information: Minimum requirement according to the standard is 40MΩ·m^2. Area of the module is 2.04m^2.							

Annex 1: List of measurement equipment

Measurement / testing	Equipment	Identification	Next calibration date
Visual inspection	Luminometer	TNRDTO002	2026-03-11
Maximum power determination	Pulsed Solar Simulator	TNRDEQ043	2025-12-02
Insulation test	Withstanding voltage / Insulation resistance tester	TNRDTI037	2025-08-07
Wet leakage current test	Withstanding voltage / Insulation resistance tester	TNRDTI037	2025-08-07
	Conductive meter	TNRDTI004	2026-03-05
Hail test	Hail impact test machine	TNRDEQ007	2026-04-26

Annex 2: Statement of the estimated uncertainty of the test results

Parameter	**Relative expanded uncertainty U_{rel}**	**Coverage factor *k***
P_{max}	2.4%	2
I_{sc}	2.3%	2
V_{oc}	0.8%	2

Annex 3: Photos

Module type: S4-DGxxx-108BC-FB

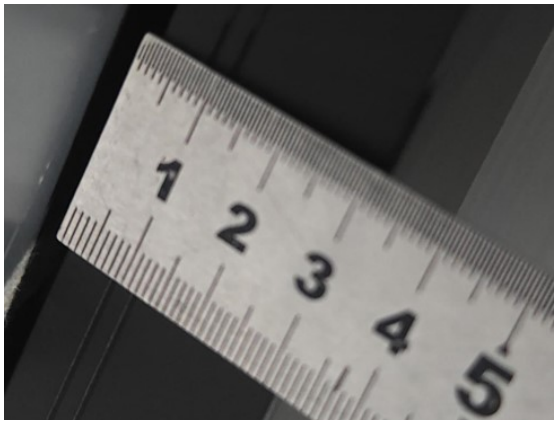
Front overview

Back overview

N/A

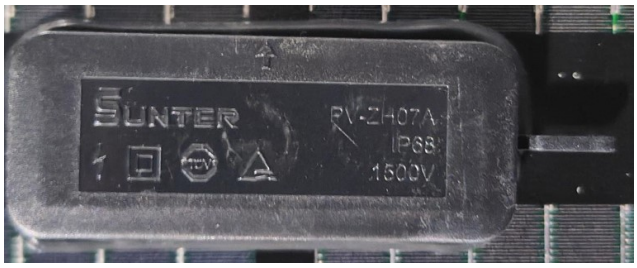
Label

Solar cell

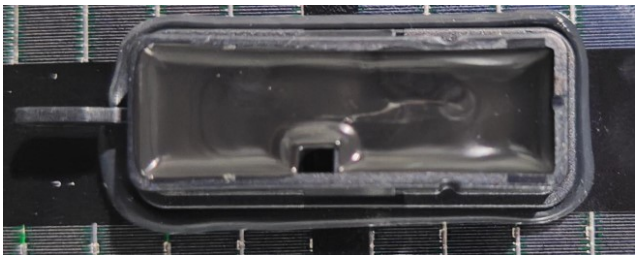


Frame

Grounding Mark



Junction box (PV-ZH07A)

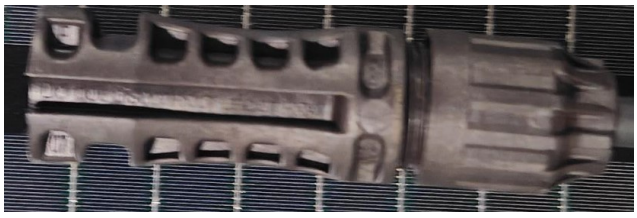


Junction box (opened)

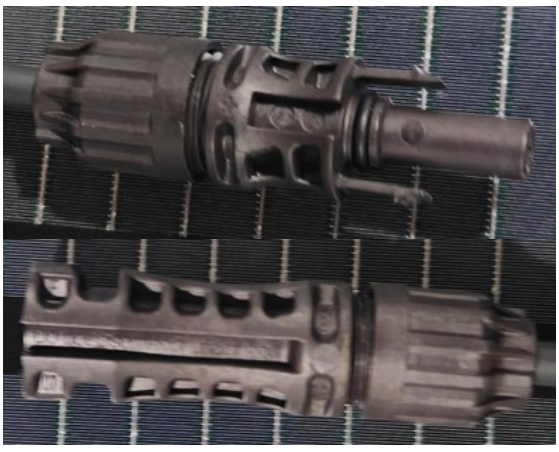
N/A

Bypass diode (Junction box is potted)

Cable (62930 IEC 131 1x4.0mm²)

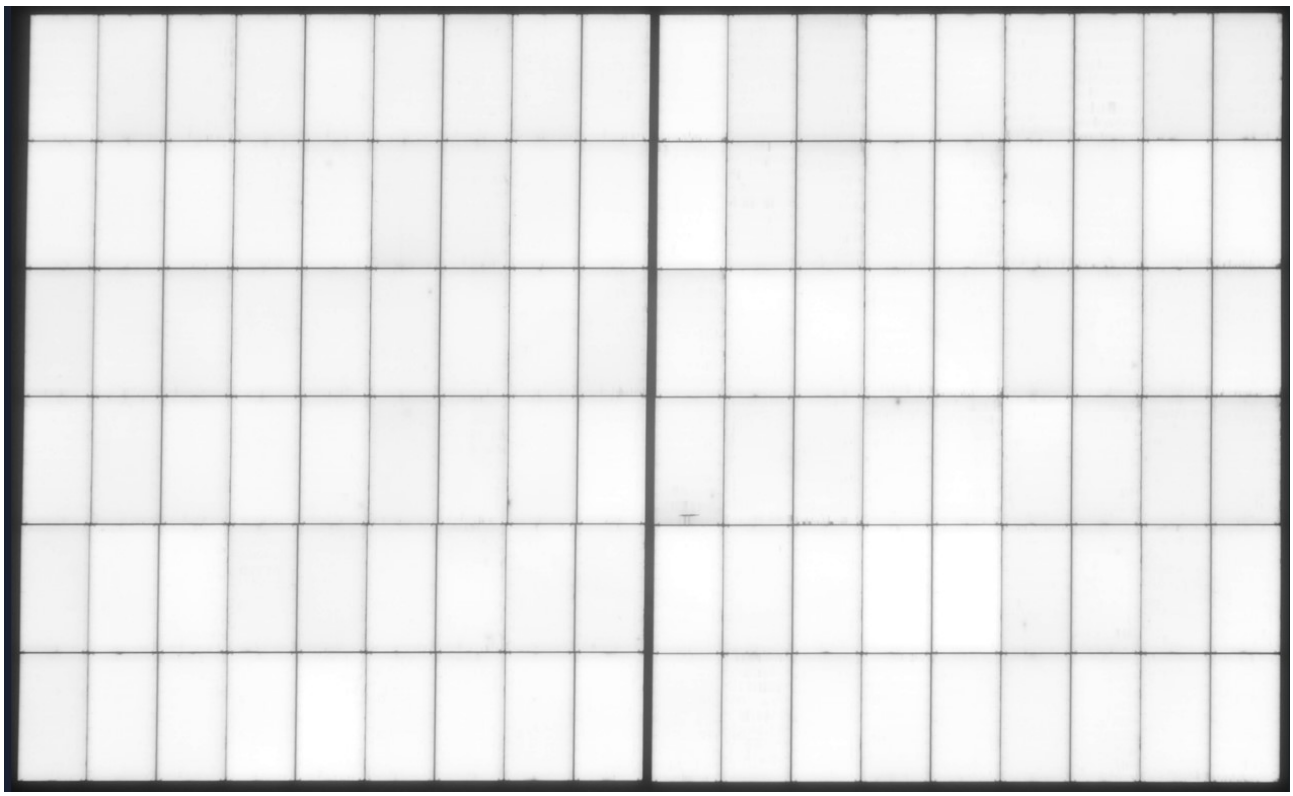


Mark (Do not disconnect under load)

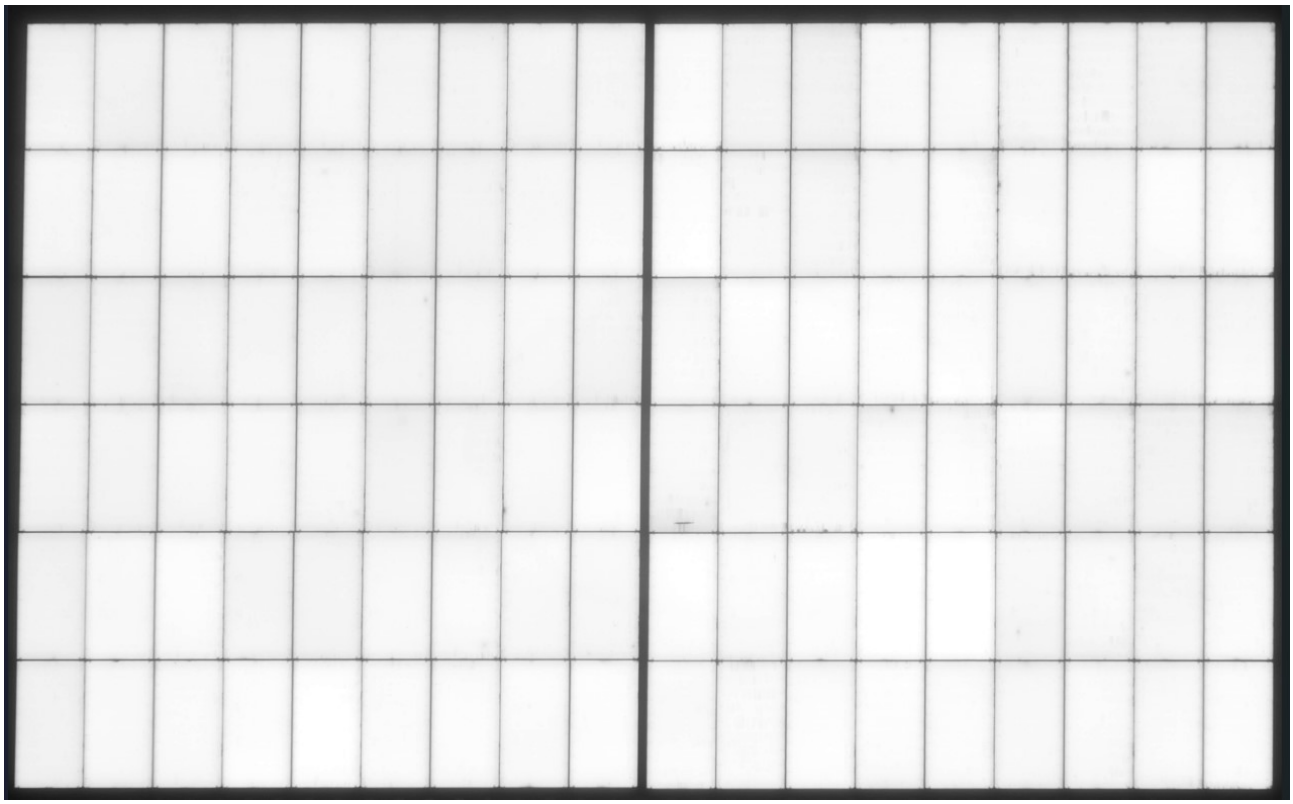


Connectors (Not specified)

Annex 5: EL images



Sample 1# (initial)



Sample 1# (after hail impact test)

----- End of test report -----